THE UNIVERSITY OF BRITISH COLUMBIA

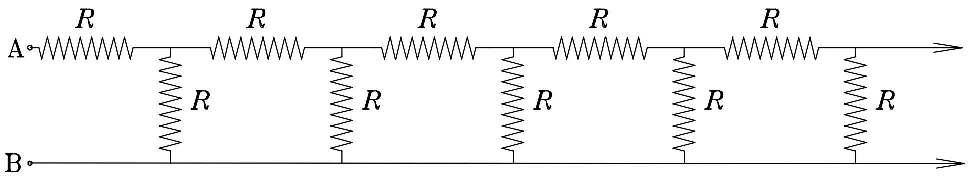
# Physics 122 Assignment # 6:

# CURRENT, RESISTANCE & DC CIRCUITS

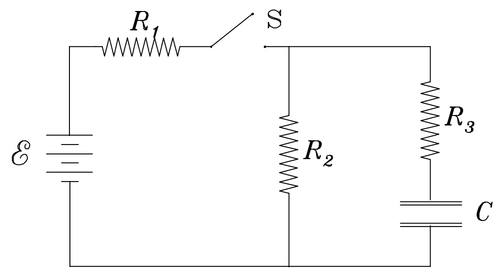
Fri. 8 Feb. 2002 — finish by Fri. 15 Feb.

**1. TRIUMF POWER USE:** The electromagnet that generates the magnetic field for the world's largest cyclotron at TRIUMF has conductors made of aluminum (resistivity $\rho = 2.8 \times 10^{-8}$ $\Omega$m) wound in a circle of radius 9.5 m. The conductor has a rectangular cross section (2.5 cm $\times$ 42 cm). There are 15 turns in the top half of the magnet and 15 in the bottom half, for a total length of 30 circumferences (the top and bottom coils are connected in series). If we apply 100 V to the coils, what current flows through it? How much power does this require to run?

**2. DISTRIBUTED LOAD:** [Challenge problem!] A power transmission line (for instance) can be modelled as an array of discrete resistors such as that shown below. If the array continues indefinitely to the right, what is the effective resistance between A and B?




**3. RC CIRCUIT TIME-DEPENDENCE:** In the circuit shown, $\mathcal{E} = 1.2$ kV, $C = 6.5$ $\mu$F and $R_1 = R_2 = R_3 = R = 0.73$ M$\Omega$. With $C$ completely uncharged, switch **S** is suddenly closed (at $t = 0$).




(*a*) Determine the currents through each resistor for $t = 0$ and as $t \to \infty$.

(*b*) Draw a qualitative graph of the potential difference $V_2$ across $R_2$ as a function of time from $t = 0$ and as $t \to \infty$.

(*c*) What are the numerical values of $V_2$ at $t = 0$ and as $t \to \infty$?

(*d*) Give the practical physical meaning of "as $t \to \infty$" in this case.

(*e*) Finally, write down expressions for the currents through $R_1$, $R_2$ and $R_3$ as functions of time, in terms of $C$ and $R$.